Chemical Characteristics of Selected Rivers in Nova Scotia and New Brunswick During 1983

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Le titre exact paraît au haut du résumé de chaque rapport.

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ABSTRACT

Ashfield, D., D.K. MacPhail, P. Mandell and G.J. Farmer. 1984. Chemical characteristics of selected rivers in Nova Scotia and New Brunswick during 1983. Can. Data Rep. Fish. Aquat. Sci. No. 489. v + 18 p.

The chemical characteristics of ten New Brunswick and Nova Scotia rivers which drain to the Bay of Fundy were measured on two occasions during 1983. Hatchery-reared juvenile salmon have been released in three of the rivers and the other seven are considered as possible sites for salmon enhancement programs. The chemical characteristics of the various river systems shown in this report can be examined to: (1) determine their sensitivity to acid precipitation, (2) facilitate the planning of salmon enhancement programs and (3) enable the selection of suitable release sites for hatchery-reared juveniles.

Key words: Atlantic salmon rivers, Nova Scotia, New Brunswick, water chemistry, salmon enhancement.

RÉSUMÉ

Ashfield, D., D.K. MacPhail, P. Mandell and G.J. Farmer. 1984. Chemical characteristics of selected rivers in Nova Scotia and New Brunswick during 1983. Can. Data Rep. Fish. Aquat. Sci. No. 489. v + 18 p.

À deux occasions en 1983, on a examiné les caractéristiques chimiques de dix cours d'eau du Nouveau-Brunswick et de la Nouvelle-Écosse qui se jettent dans la baie de Fundy. On a ensemencé trois des cours d'eau en saumoneaux d'élevage et l'on envisage d'ensemencer les sept autres dans le cadre des programmes de mise en valeur de saumon. On peut examiner les caractéristiques chimiques de ces réseaux de rivières à trois fins: (1) déterminer leur sensibilité aux pluies acides, (2) faciliter la planification des programmes de mise en valeur du saumon et (3) permettre la sélection de lieux d'ensemencement appropriés en saumoneaux d'élevage.

INTRODUCTION

A number of mainland Nova Scotia rivers which drain to the Atlantic coast have become more acidic during at least the past 30 years in response to increased acid loading by precipitation (Watt et al. 1983). The most seriously acidified rivers are those found on bedrock composed of granite and/or greywacke, and in some rivers, the native populations of Atlantic salmon have become extinct. Rivers which lie on slate have higher pH values and the highest values are found for rivers which drain areas of carboniferous sediments. Watt et al. (1983) also demonstrated that the pH values of some rivers are inversely correlated with their rates of discharge, so that pH values are maximal during the late summer when discharge is lowest and minimal during the winter when discharge is usually greatest.

Only limited information of the chemical characteristics of rivers which drain to the Fundy side of Nova Scotia and New Brunswick is presently available. Thus, the chemical characteristics of ten of these rivers were measured in 1983, during a period of high discharge and one of low discharge. Selection of the two sampling periods was made to gain insight into the rangesof pH which presently occur in the rivers. The major tributaries of the ten rivers were sampled on both occasions to provide information on the chemical characteristics of each river's entire drainage area.

Hatchery-reared juvenile salmon have been released in three of the selected rivers and the other seven are considered as possible sights for enhancement programs. The results of the chemical analyses can be examined to determine the sensitivity of the various river systems to acid precipitation, to facilitate the planning of new salmon enhancement programs and to enable the selection of suitable release sites for hatchery-reared juveniles.

MATERIALS AND METHODS

Several sites on the Meteghan, Annapolis, Cornwallis, Meander, Herbert, Kennetcook, Cogmagun and Walton rivers in Nova Scotia and on the Petitcodiac and Point Wolfe rivers in New Brunswick were visited during the June-July period and again during the November-December period of 1983 to obtain water samples. Samples were collected at each site in 500-ml polyethylene containers which had first been washed and then rinsed with deionized water. Samples taken for metal analyses were collected in 250-ml polyethylene containers which had first been washed in a 50% HNO_3 solution and then rinsed with deionized water. Each sample for metal analysis was preserved by the addition of 1-ml of 50% HNO_3 solution. All chemical analyses of river water were performed upon return to the laboratory. A Metrohm Herisau pH meter was used to determine the pH values of all sites within 24 hours of sampling. Total hardness, total alkalinity, chloride and sulfate were measured by using techniques outlined in Environment Canada (1981): total hardness, as $CaCO_3$ by EDTA titration to Eriochrome Black T colour change; total alkalinity as $CaCO_3$ by potentiometric titration with H_2SO_4 to pH end points of 4.5 and 4.2; chloride by the automated thiocyanate method; and sulfate by titration with barium chloride, after adding thorin indicator. Specific conductance was determined at 25°C by use of a Metrohm Herisau conductivity meter and apparent colour was measured with a Helige Aqua Tester. Concentrations of calcium, magnesium and aluminum were determined by emission spectrophotometer (Jarrel-Ash, AtomComp).

ACKNOWLEDGEMENTS

We are indebted to O. Vaidya who conducted the metal analyses and to W. Horne who provided valuable assistance with the chloride determinations. Mrs. C. Dares typed the manuscript; G. Bernard photographed the illustrations and prepared the cover artwork. R.E.H. Smith reviewed the manuscript and provided valuable editorial comments.

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TABLE 1. Some chemical characteristics of the Miteghan River system during December of 1983.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al
							(mg/L)				(µg/L)
December 12											
M1	Above head of tide	5.57	0.8	8.3	48.1	110	2.0	1.2	8.6	4.3	280
M2	Below Lac à Victor	5.50	0.7	8.2	47.8	110					
M3	Thibault Brook	5.50	1.0	11.3	56.2	110					
M4	Above Lac à Victor	5.41	0.6	8.3	47.1	110					
M5	Below Ameros Lake	5.45	0.9	9.3	51.9	110					

TABLE 2. Some chemical characteristics of the Annapolis River system during June, November and December of 1983.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (μS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al
							(mg/L)				(μg/L)
June 1											
E1	Above head of tide	6.66	9.2	17.1	62.4	100	4.5	1.2	8.4	6.2	230
E2	Round Hill River	5.81	1.1	5.1	29.5	110					
E3	West Branch, Round Hill River	5.70	2.0	6.3	32.3	130					
E4	East Branch, Round Hill River	5.22	<0.5	3.9	27.4	110					
E5	Bloody Creek	6.22	2.6	8.8	35.9	90					
E6	Paradise Brook	6.60	7.8	12.7	48.8	55					
E7	Barteaux Brook	5.99	1.2	5.8	26.1	100					
E8	McEwan Brook	7.00	26.9	49.5	156.0	110					
E9	Nictaux River, near mouth	5.76	0.8	5.7	29.5	110					
E10	Oakes Brook	5.39	1.2	5.2	34.4	120					
E11	Nictaux River, above Cowlings Meadows	5.02	<0.5	3.9	25.6	110					
E12	Fales River	5.92	1.2	7.8	26.5	130					
E13	South River	6.17	2.4	6.6	31.5	65					
E14	Hutchinson Brook	6.27	6.5	16.8	55.1	90					
E15	Rockland Brook	6.23	8.5	15.1	51.8	95					
E16	Black River	6.62	7.9	13.3	41.4	130					
November 28											
E1	Above head of tide	6.83	11.6	31.9	107.8	75	11.6	2.3	11.4	15.2	240
E2	Round Hill River	5.05	<0.5	7.8	40.7	110					
E3	West Branch, Round Hill River	5.23	<0.5	10.2	47.8	120					
E4	East Branch, Round Hill River	4.60	<0.5	6.5	40.7	120					
E5	Bloody Creek	5.60	1.2	10.8	44.8	110					
E6	Paradise Brook	5.78	1.2	8.3	43.1	90					
E7	Barteaux Brook	5.48	<0.5	7.4	38.5	100					
E8	McEwan Brook	7.02	21.5	58.3	189.2	65					
E9	Nictaux River, near mouth	6.29	3.4	10.6	47.4	70					
E10	Oakes Brook	4.95	<0.5	10.1	55.4	120					
E11	Nictaux River, above Cowlings Meadows	5.45	<0.5	5.0	33.2	75					
E12	Fales River	5.99	2.5	12.3	49.5	120					
E13	South River	6.45	5.6	14.7	57.2	65					
E14	Hutchinson Brook	5.89	2.7	14.7	53.0	110					
E15	Rockland Brook	6.70	14.2	27.9	92.6	50					
E16	Black River	6.09	2.7	14.1	49.3	130					
E17	Eight Mile Brook	4.52	<0.5	7.6	47.1	150					
December 12											
E2	Round Hill River	5.04	<0.5	8.8	46.2	110					
E3	West Branch, Round Hill River	5.24	<0.5	11.0	54.3	110					
E4	East Branch, Round Hill River	4.64	<0.5	7.5	43.7	100					
E17	Eight Mile Brook	4.50	<0.5	8.3	52.1	130					

TABLE 3. Some chemical characteristics of the Cornwallis River system during June and November of 1983.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (μS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (μg/L)
							(mg/L)				
June 16											
A1	Above head of tide	7.27	41.0	72.7	197.6	25	20.2	2.6	16.4	18.6	<25
A2	Brandywine Brook	7.58	61.8	102.4	284.4	45					
A3	Coleman Brook	7.56	64.6	105.6	252.7	25					
A4	At Coldbrook Hatchery	7.12	10.0	22.5	78.3	15					
A5	Rand Brook	8.18	56.1	80.9	197.6	15					
A6	Cornwallis River at Berwick North	7.41	61.3	172.7	387.7	25					
November 22											
A1	Above head of tide	7.18	38.3	81.6	227.8	15	33.6	3.6	19.0	27.0	40
A2	Brandywine Brook	7.48	56.5	106.3	263.5	25					
A3	Coleman Brook	7.45	52.7	105.4	261.4	20					
A4	At Coldbrook Hatchery	7.06	9.7	25.5	86.4	10					
A5	Rand Brook	7.52	46.5	93.6	241.9	55					
A6	Cornwallis River at Berwick North	7.29	51.4	190.1	436.3	25					

TABLE 4. Some chemical characteristics of the Meander River system during June and November of 1983.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (μS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (μg/L)
							(mg/L)				
June 16											
F1	Above head of tide	7.55	17.3	64.7	168.5	25	19.9	1.3	7.2	42.0	<25
F2	Little Meander River	7.11	7.5	15.2	57.2	15					
F3	Above Little Meander River	6.62	2.3	10.5	40.7	35					
F4	Brook below Cockscomb Lake	6.32	1.5	5.6	39.9	45					
F5	Below Cockscomb Lake	6.32	4.4	5.7	38.2	55					
November 22											
F1	Above head of tide	7.20	21.2	72.5	197.6	30	50.6	3.1	12.6	44.0	130
F2	Little Meander River	6.77	5.7	17.2	65.1	20					
F3	Above Little Meander River	6.10	1.4	9.1	44.3	40					
F4	Brook below Cockscomb Lake	6.21	4.3	11.5	57.2	50					
F5	Below Cockscomb Lake	5.80	0.7	7.8	41.0	30					

TABLE 5. Some chemical characteristics of the Herbert River system during June and November of 1983.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (µg/L)
							(mg/L)				
June 23											
C1	Above head of tide	6.93	6.9	33.3	103.0	25	10.8	1.1	6.2	21.5	<25
C2	Herbert River, above Woodville	6.23	2.3	7.4	40.1	45					
C3	Herbert River, above Nix Brook	6.01	0.9	4.9	29.6	55					
C4	O'Hearn Brook	5.13	<0.5	4.7	33.8	130					
C5	Herbert River, below O'Hearn Brook	5.11	<0.5	4.1	37.7	130					
November 23											
C1	Above head of tide	6.10	2.2	25.2	74.9	60	12.3	1.0	5.0	18.4	250
C2	Herbert River, above Woodville	5.28	<0.5	6.9	32.9	60					
C3	Herbert River, above Nix Brook	4.98	<0.5	6.0	31.3	65					
C4	O'Hearn Brook	4.53	<0.5	6.7	39.9	110					
C5	Herbert River, below O'Hearn Brook	4.63	<0.5	6.4	38.0	100					

TABLE 6. Some chemical characteristics of the Kennetcook River system during June and November of 1983.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (µg/L)
							(mg/L)				
June 8											
B1	Above head of tide	6.91	12.0	43.8	223.6	90	14.5	1.5	34.7	28.0	<25
B2	Little River	6.93	12.9	58.4	174.9	55					
B3	Tomcod River	4.88	<0.5	2.4	31.1	260					
B4	Cayley Brook	6.90	22.0	44.6	111.2	130					
B5	Glen Brook	6.85	9.8	55.3	177.1	30					
B6	Birch Brook	6.99	11.2	65.7	153.4	55					
B7	Robinson Brook	6.43	3.5	7.2	26.7	40					
B8	Ettinger Brook	7.05	19.2	80.8	343.4	120					
B9	Hennigar Brook	6.75	6.4	17.6	47.1	60					
B10	Allison Brook	6.46	3.6	9.2	30.1	75					
November 23											
B1	Above head of tide	6.48	5.7	34.3	154.4	65	13.8	1.7	22.4	17.5	230
B2	Little River	6.38	4.3	37.7	131.8	55					
B3	Tomcod River	4.39	<0.5	11.9	62.9	200					
B4	Cayley Brook	6.87	12.6	87.8	233.3	60					
B5	Glen Brook	6.60	5.1	38.7	113.4	30					
B6	Birch Brook	6.67	6.1	51.7	143.6	50					
B7	Robinson Brook	5.60	0.6	7.5	30.6	60					
B8	Ettinger Brook	6.80	13.4	85.1	335.9	95					
B9	Hennigar Brook	6.30	3.3	16.5	51.4	55					
B10	Allison Brook	5.88	1.3	11.8	33.7	65					

TABLE 7. Some chemical characteristics of the Cogmagun River system during June and November of 1983.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (µg/L)
							(mg/L)				
June 20											
D1	Above head of tide	6.61	14.4	23.7	132.6	220	6.5	1.3	21.4	9.8	90
D2	Threemile Brook	6.05	9.4	14.2	41.3	220					
November 23											
D1	Above head of tide	5.50	1.1	17.0	77.9	130	5.7	1.6	11.0	11.3	450
D2	Threemile Brook	5.71	4.8	21.7	81.1	120					
D3	South Branch, Cogmagun River	4.65	<0.5	7.6	56.4	140					

TABLE 8. Some chemical characteristics of the Walton River system during June and November of 1983.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (µg/L)
							(mg/L)				
June 20											
G1	Above head of tide	6.44	2.8	5.2	33.5	180	1.3	0.5	3.9	2.9	150
November 23											
G1	Above head of tide	5.08	<0.5	8.1	42.7	100	2.3	1.0	5.4	5.8	430

TABLE 9. Some chemical characteristics of the Petitcodiac River system during July and December of 1983.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (µS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (µg/L)
							(mg/L)				
July 6											
K1	Above head of tide	7.16	27.9	42.9	187.7	65	12.9	1.9	21.8	20.0	120
K2	Turtle Creek	7.29	15.5	17.8	65.3	25					
K3	Coverdale River	7.48	20.3	23.3	72.4	25					
K4	Pollett River	7.41	14.8	17.4	60.2	25					
K5	Anagance River	6.65	16.8	18.6	62.3	65					
K6	North River	7.42	50.8	154.4	510.0	55					
December 5											
K1	Above head of tide	6.98	12.7	26.3	98.6	25	10.3	1.4	10.0	13.8	150
K2	Turtle Creek	6.70	9.1	12.5	38.4	25					
K3	Coverdale River	7.00	12.3	16.6	50.0	15					
K4	Pollett River	6.85	8.7	13.2	41.3	15					
K5	Anagance River	6.11	6.6	11.8	44.8	55					
K6	North River	7.29	34.6	105.1	394.3	55					

TABLE 10. Some chemical characteristics of the Point Wolfe River system during July and December of 1983.

Site	Site name	pH	Total alkalinity (mg/L)	Total hardness (mg/L)	Specific conductance (μS/cm)	Apparent colour (relative units)	Ca	Mg	Cl	SO_4	Al (μg/L)
							(mg/L)				
July 6											
J1	Above head of tide	7.09	11.9	16.2	52.0	15	5.0	0.9	3.5	5.8	<25
J2	Bennett Brook	7.08	6.4	10.2	30.8	25					
J3	Wolfe Lake	6.74	2.6	4.9	22.3	75					
J4	Point Wolfe River, above Victor Brook	6.65	7.0	9.8	29.6	15					
December 5											
J1	Above head of tide	6.55	3.5	8.9	31.8	15	3.3	0.6	2.4	4.3	140
J2	Bennett Brook	6.10	2.6	8.4	29.0	40					
J3	Wolfe Lake	5.89	3.0	7.6	34.1	25					
J4	Point Wolfe River, above Victor Brook	6.28	3.0	7.8	27.8	15					

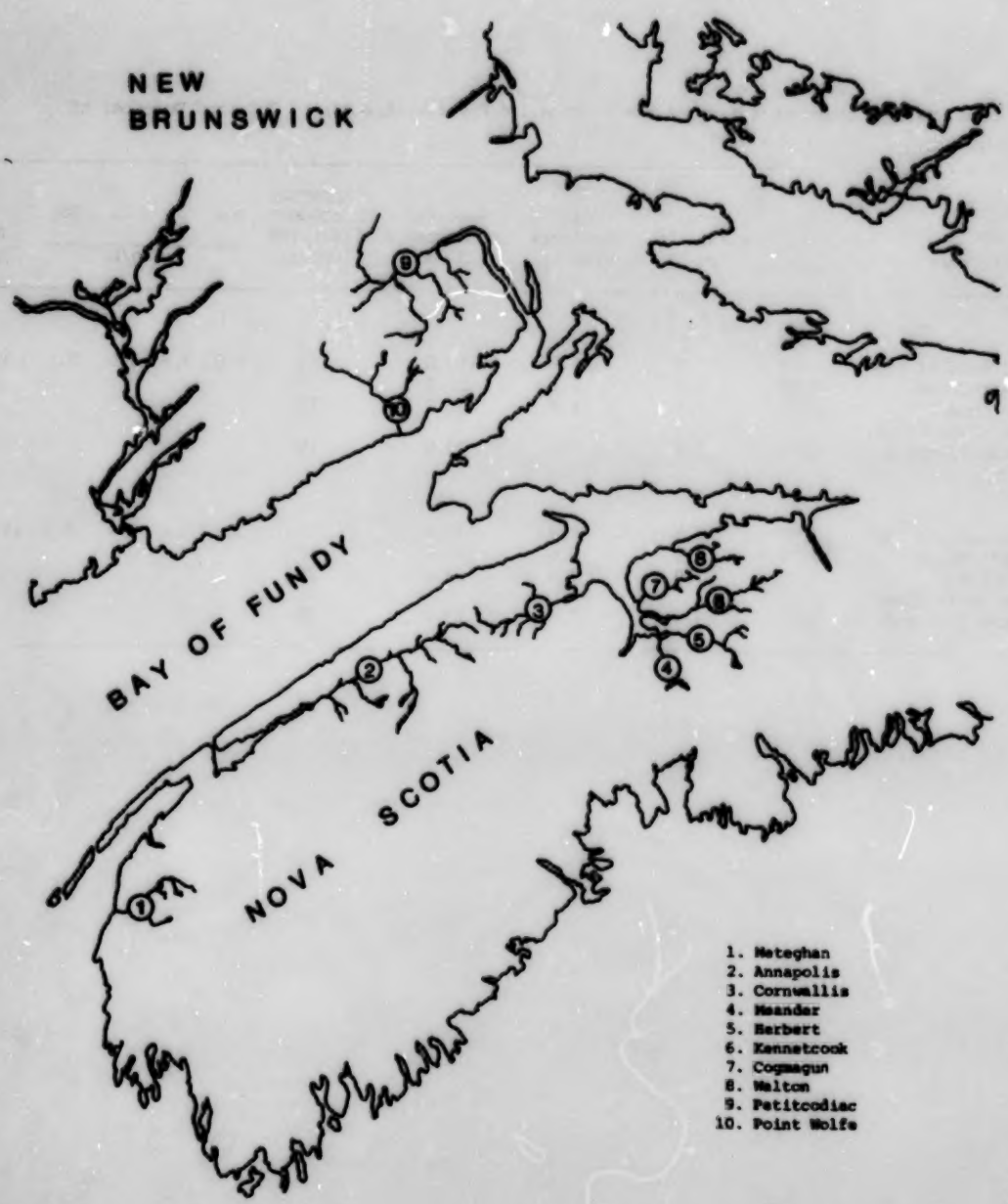

FIG. 1. Location of the rivers included in the sampling program.

FIG. 2. Water sampling sites on the Meteghan River.

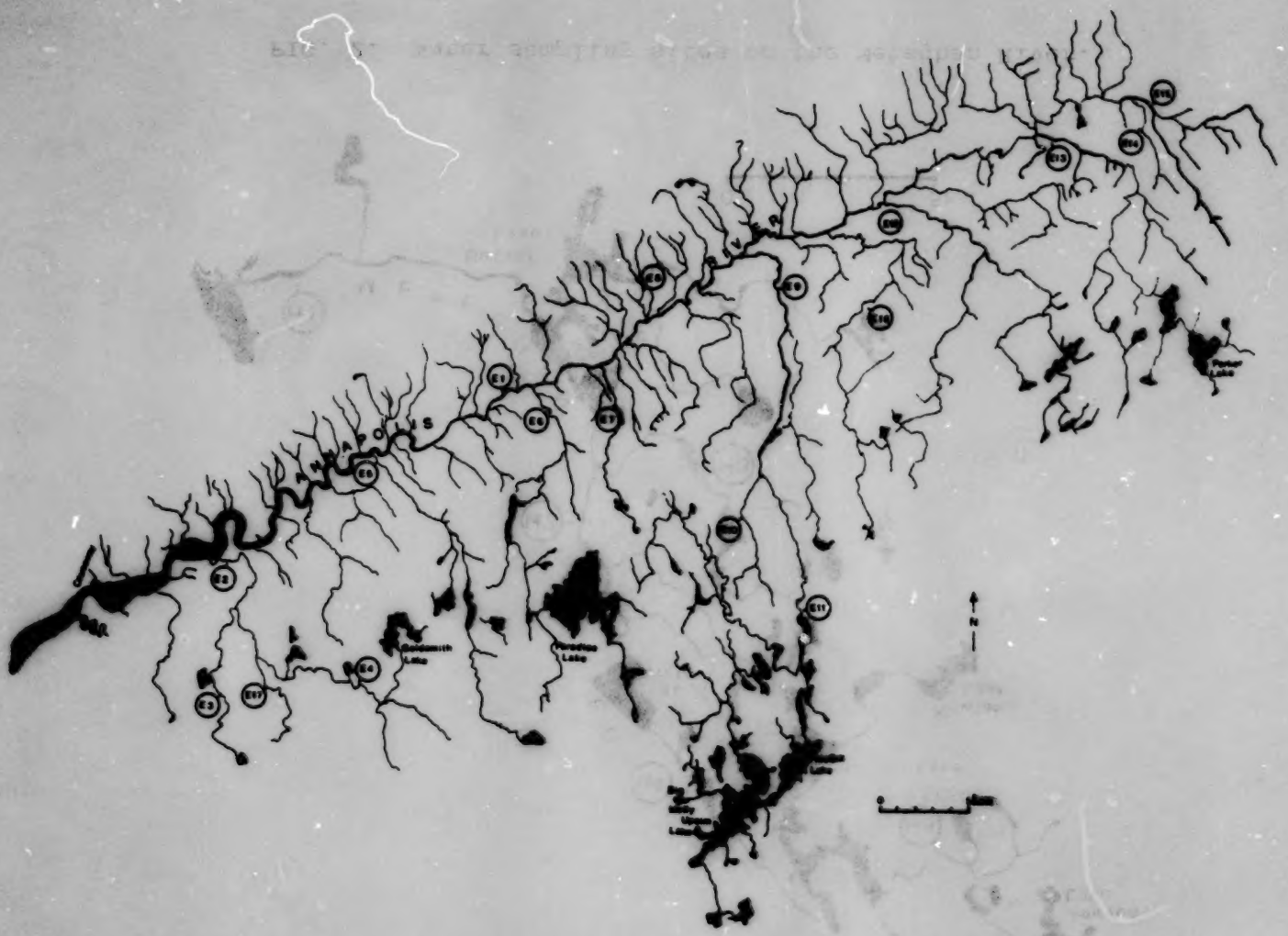

Fig. 3. Water sampling sites on the Annapolis River

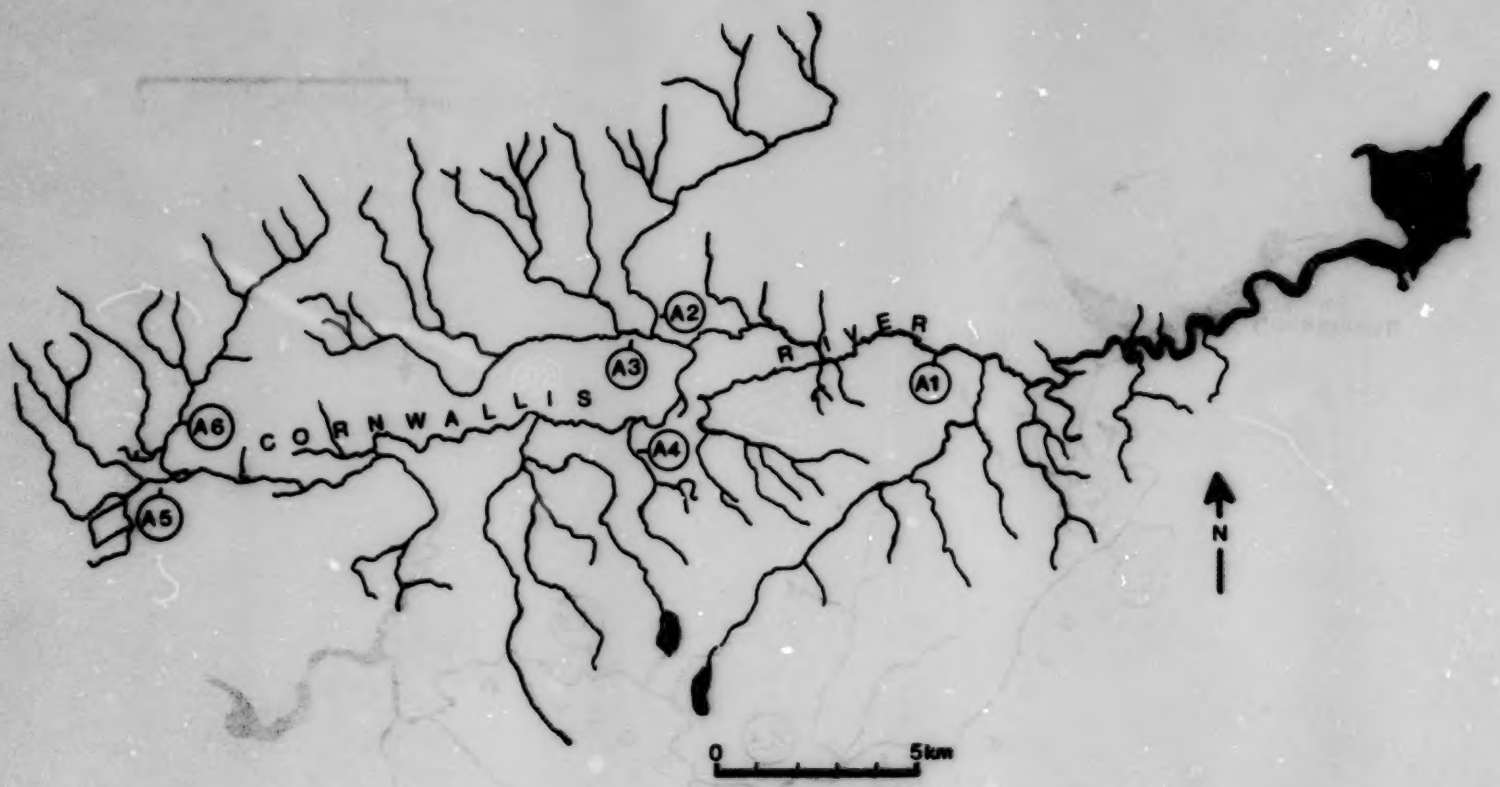

FIG. 4. Water sampling sites on the Cornwallis River.

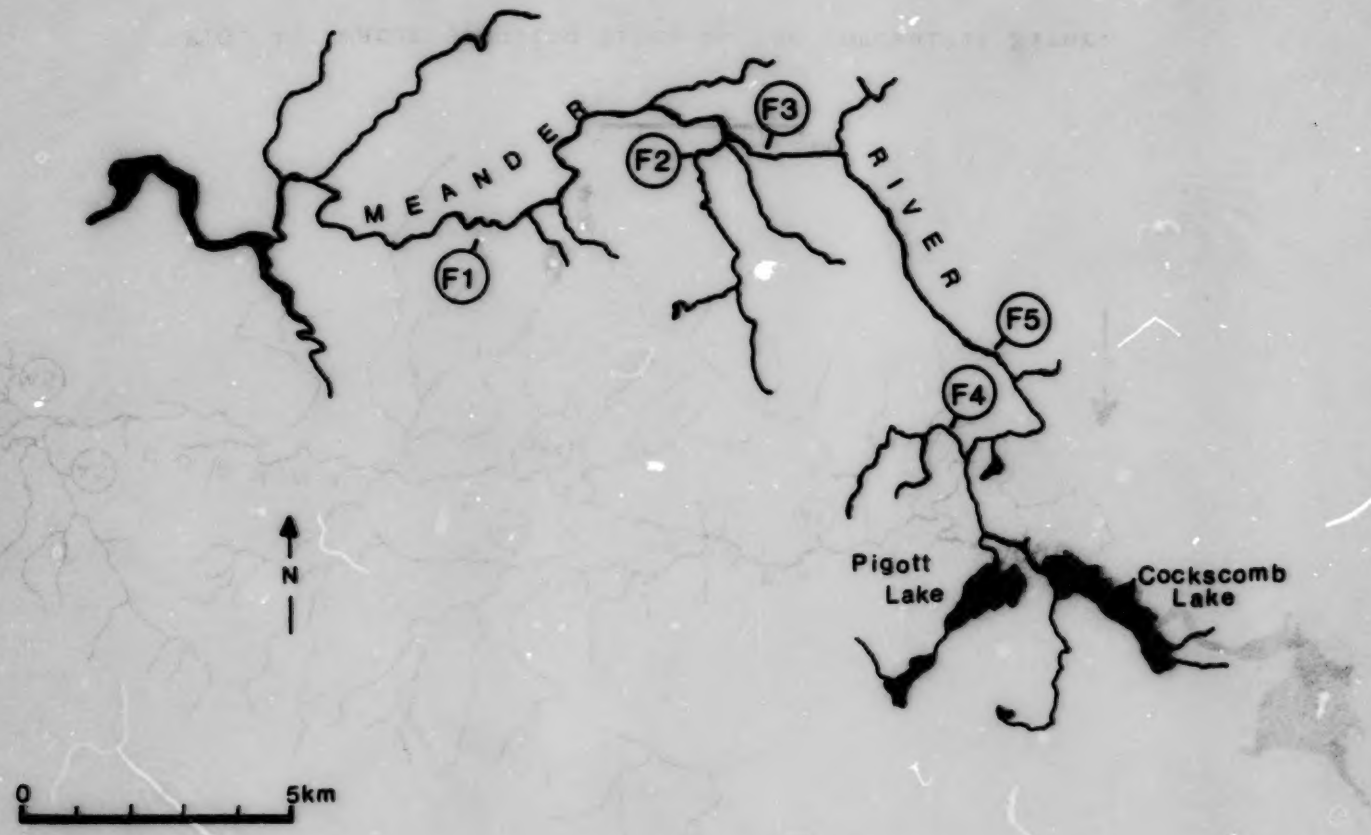

FIG. 5. Water sampling sites on the Meander River.

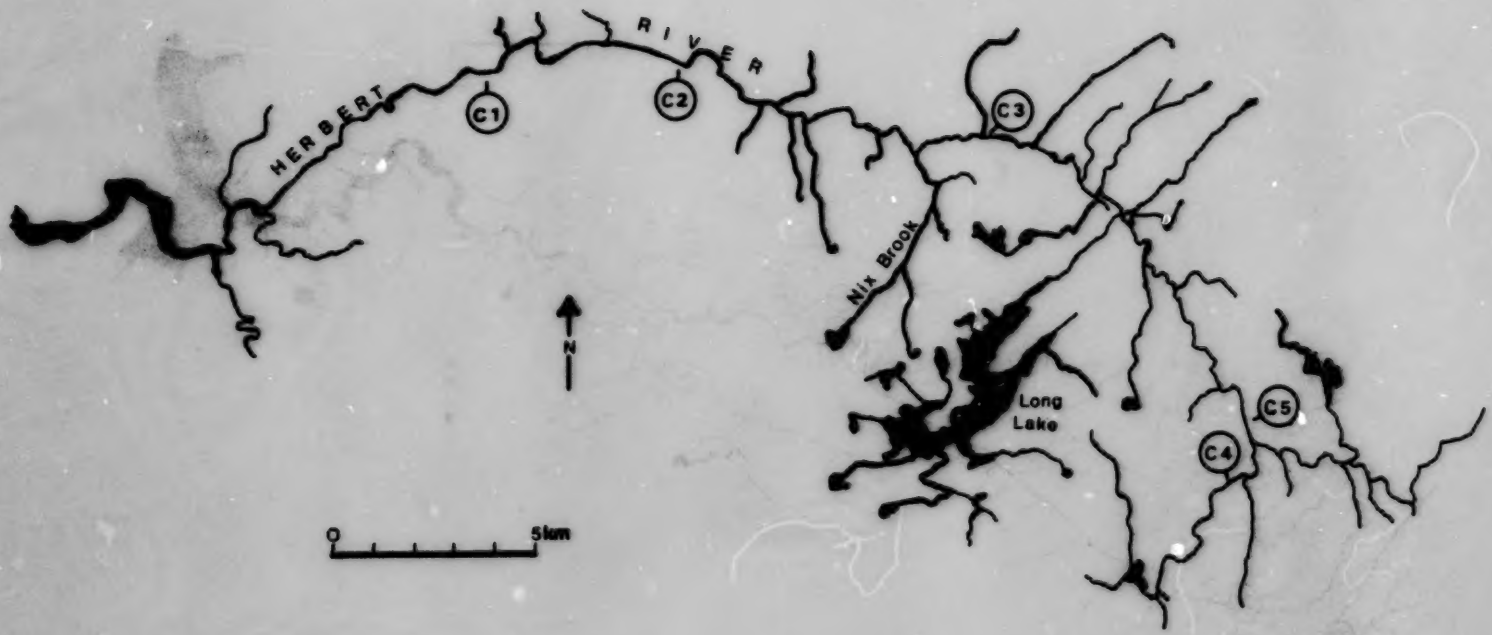

FIG. 6. Water sampling sites on the Herbert River.

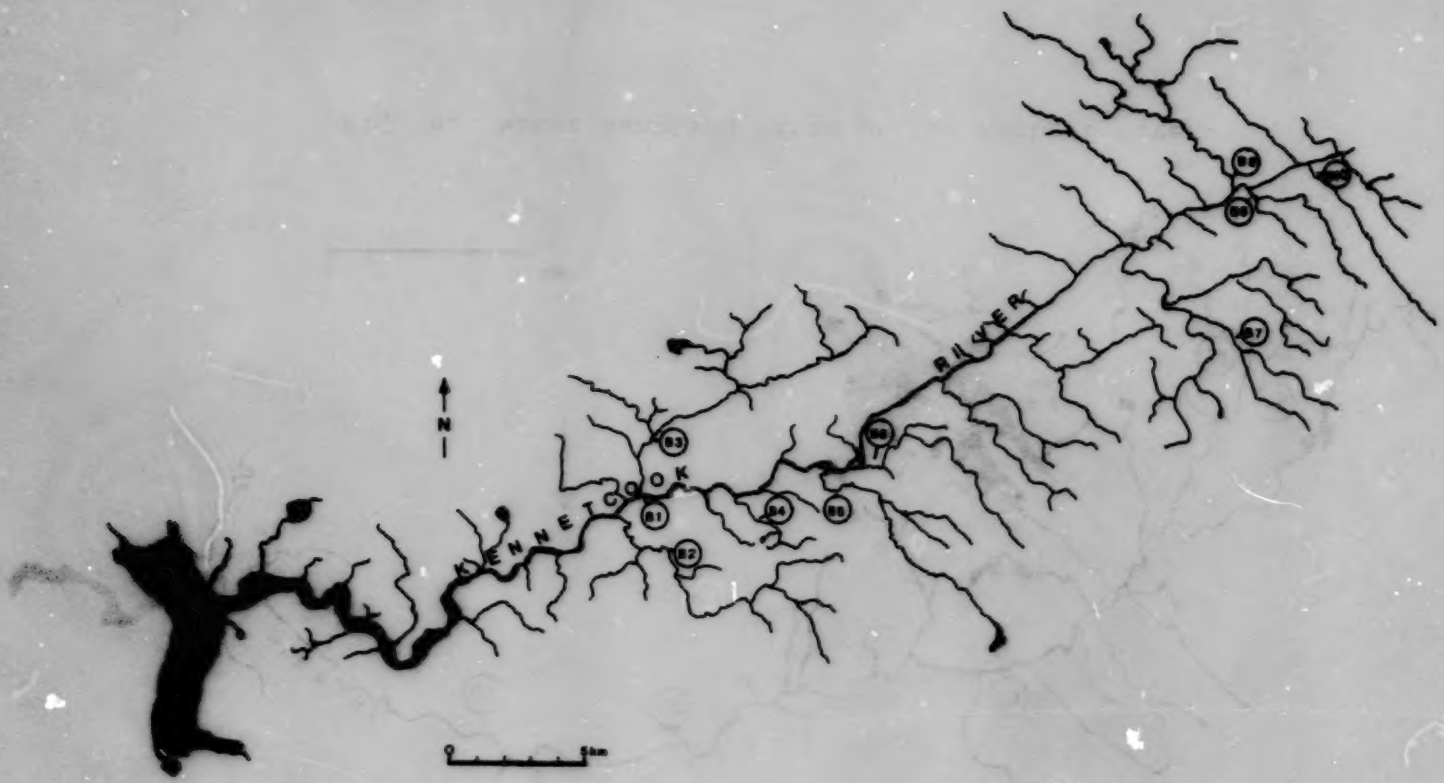

FIG. 7. Water sampling sites on the Kennetcook River.

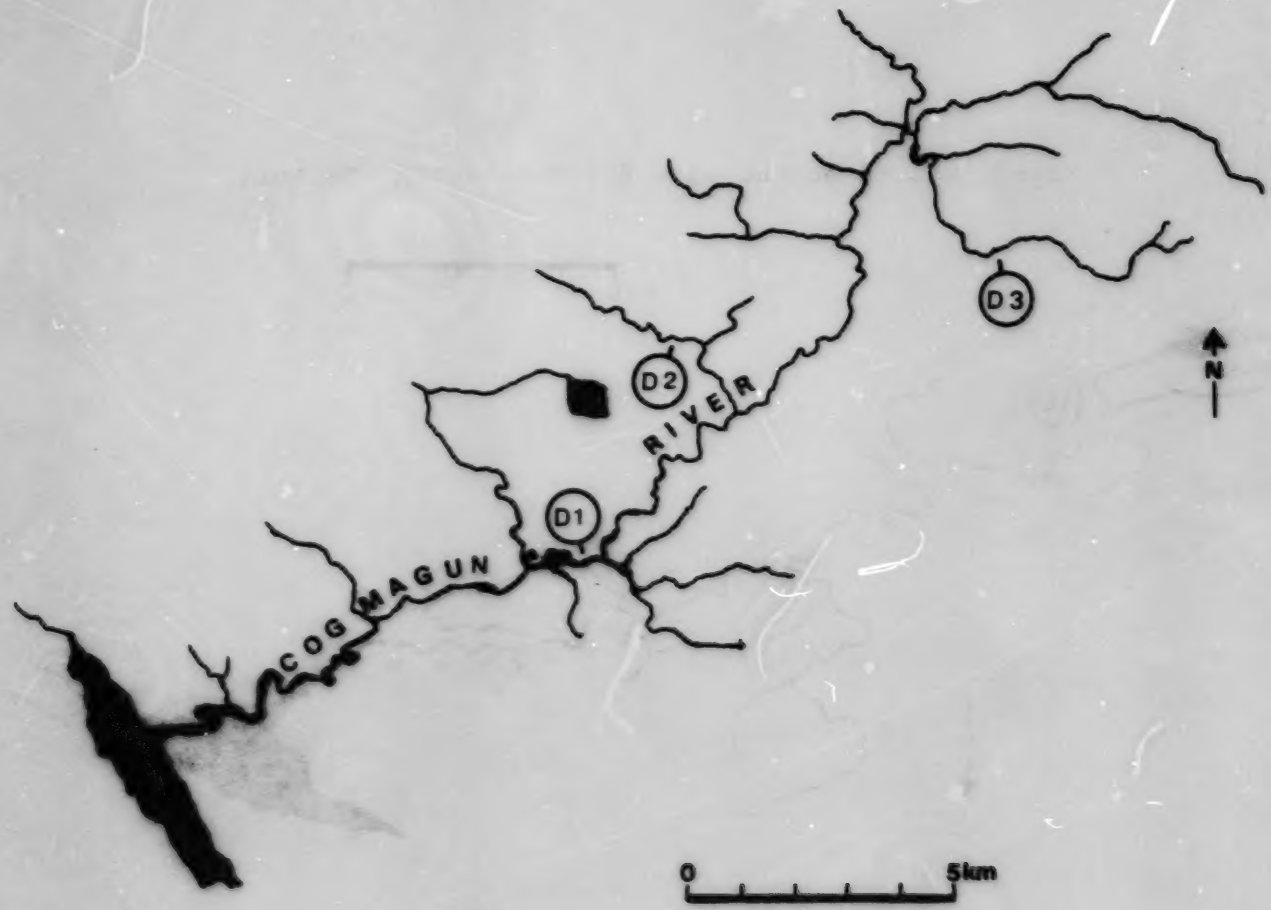

FIG. 8. Water sampling sites on the Cogmagun River.

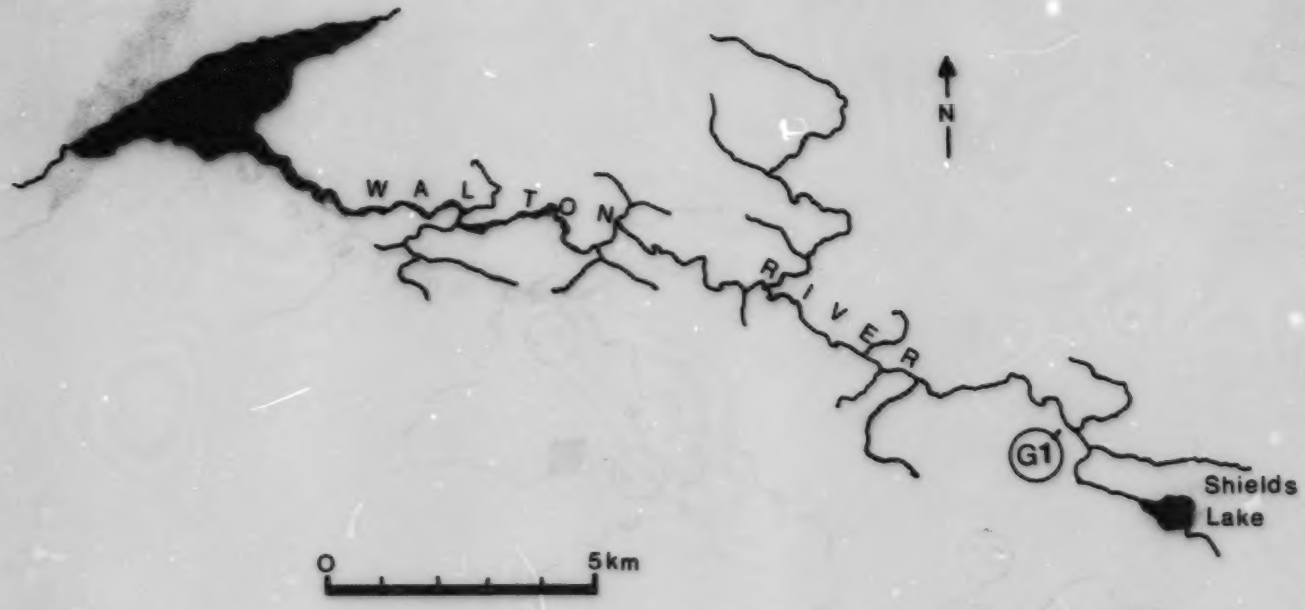

FIG. 9. Water sampling site on the Walton River.

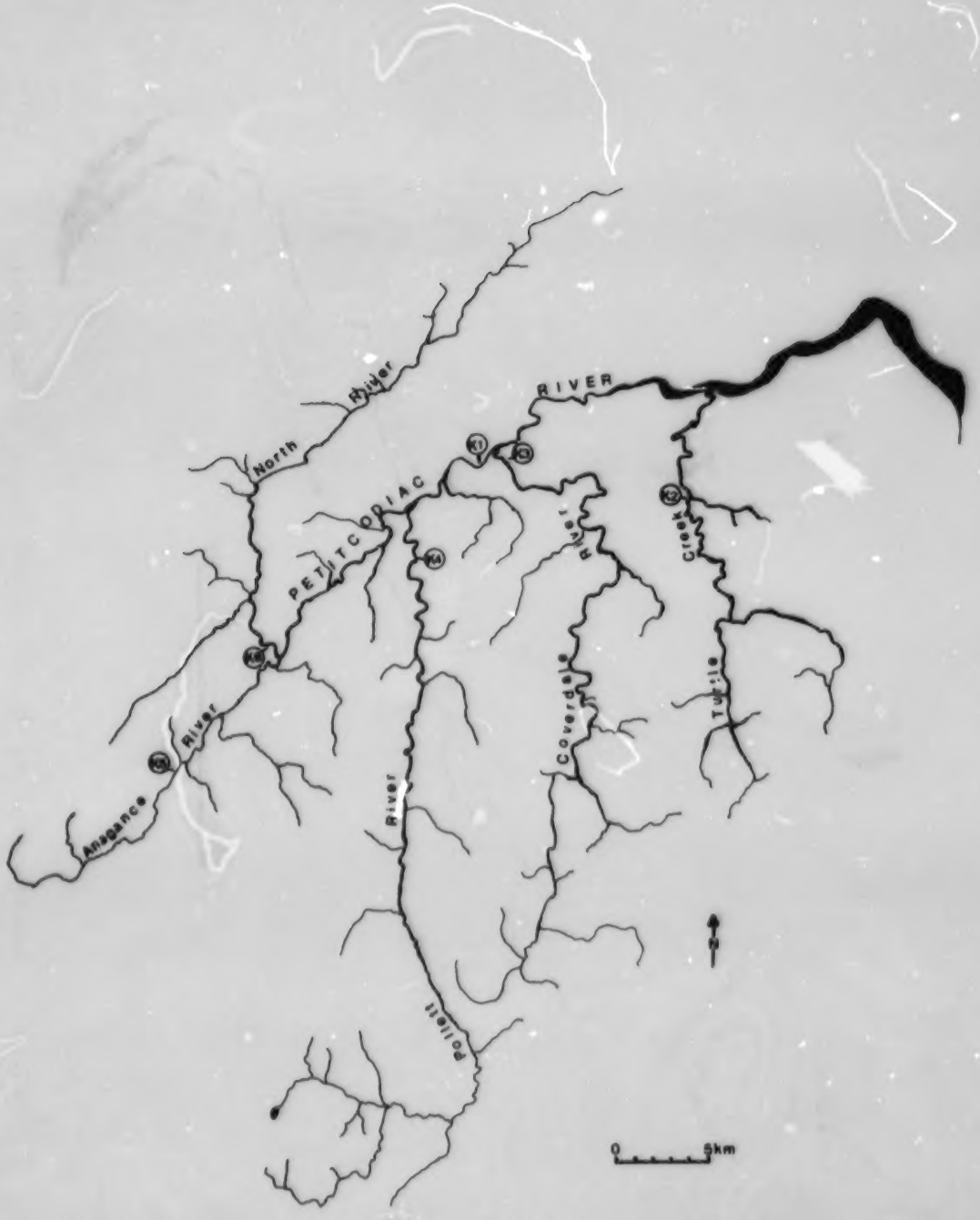

FIG. 10. Water sampling sites on the Petitcodiac River.

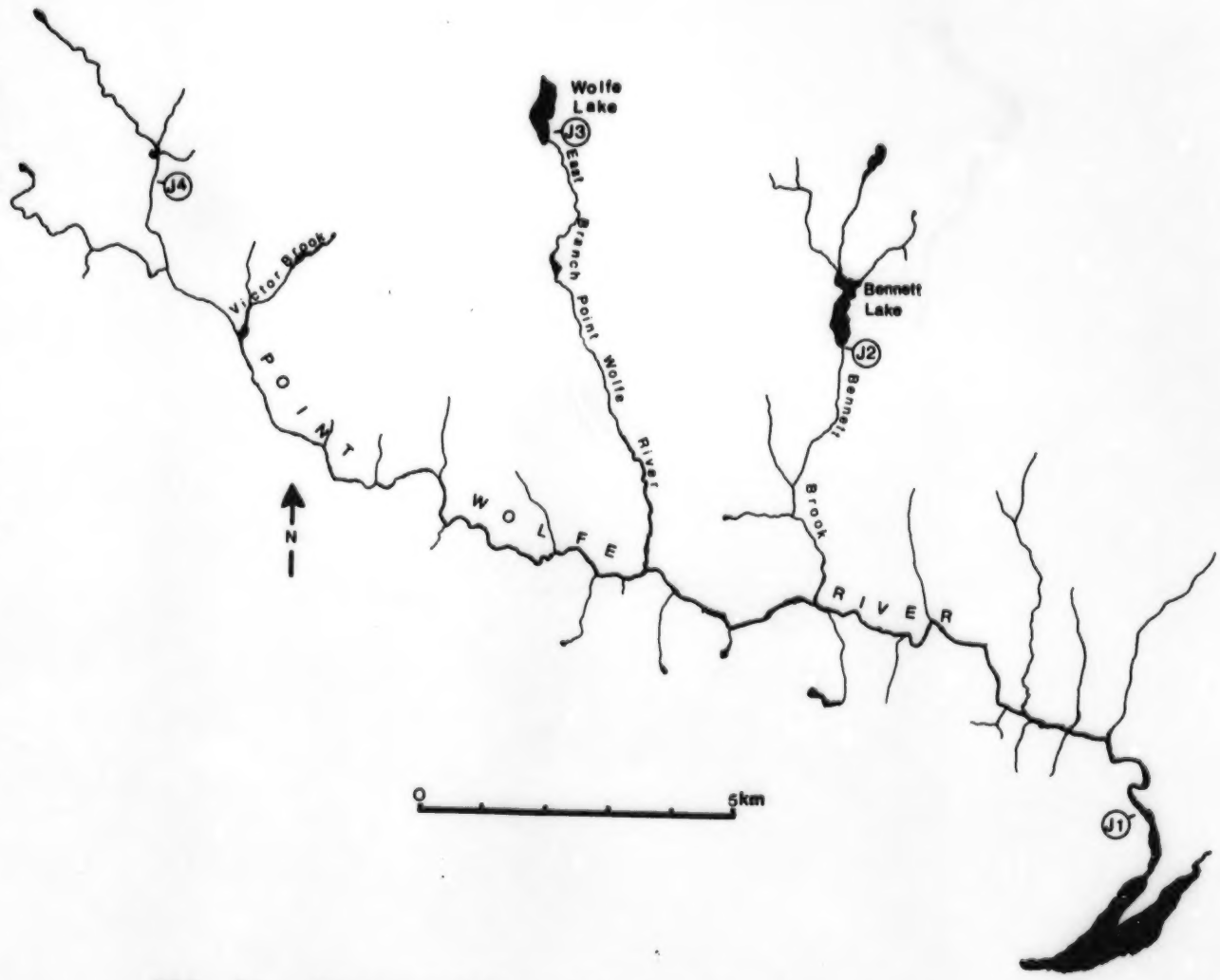

FIG. 11. Water sampling sites on the Point Wolfe River.